MIS Quarterly

RESEARCH ARTICLE

A NOMOLOGICAL NETWORK OF KNOWLEDGE MANAGEMENT SYSTEM USE: ANTECEDENTS AND CONSEQUENCES[1]

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A key objective of knowledge management system (KMS) implementations is to facilitate job outcomes, such as job performance and job satisfaction. Prior KMS research indicates many KMS implementations have failed to achieve their intended job outcomes, such as job performance and job satisfaction, and one important reason for failure could be that employees do not know how to use a KMS to enhance job outcomes. Given that research on this topic is scant and the findings inconsistent, this paper sought to develop a better understanding of the topic. Specifically, we examine how employees can use a small number of KMS features to get a majority of their job tasks done. Limited research has used a systematic approach to identify these features, examined drivers of using these features, and impacts of the use of such features on job outcomes. Based on a literature review, we first identified several KMS features. Then, these features were examined using a qualitative study among 35 employees in a large organization in the finance industry to identify the key KMS features that could contribute positively to job outcomes. We then developed a nomological network of KMS feature use. Leveraging social network theory, we present peer support ties in general, and help-seeking ties and help-providing ties in particular, as key drivers of the use of these features and job outcomes. We also present various competing hypotheses for the effects from peer support to KMS feature use, KMS feature use to job outcomes, and peer support to job outcomes. We conducted a quantitative study (n = 1,441) in the same organization (noted above) to validate our model. Results indicated that our model was largely supported.

Keywords: KMS implementation, KMS design features, help-seeking ties, help-providing ties, job performance, job satisfaction

Introduction

Knowledge management is vital to organizations, as evidenced by the continued growth of organizational investment in knowledge management systems (KMSs) (Young et al. 2008; Knox 2012) that are "a class of information systems applied to managing organizational knowledge" (Alavi and Leidner 2001, p. 114). However, studies indicate that many KMS implementations have failed to achieve their intended job outcomes, such as job performance and job satisfaction (e.g., Edwards et al. 2005; Haas and Hansen 2005). One reason for the failure is that employees might not know how to use a KMS to enhance job outcomes (e.g., Alavi and Leidner 2001; He and Wei 2006). Therefore, the topic of how

[1]Suprateek Sarker was the accepting senior editor for this paper. Atreyi Kankanalli served as the associate editor.

employees can better use a KMS to enhance job outcomes is of great interest both in the academic and trade press.

In examining KMS implementations, only a few studies have examined individual performance and the findings were not always consistent (e.g., Gallivan et al. 2003; Kankanhalli et al. 2011; Ko and Dennis 2011). For example, one study found that the use of an integrated multifunction KMS decreased employees' performance (Gallivan et al. 2003), whereas other studies showed that KMS use had a significant and positive effect on individual performance (Kankanhalli et al. 2011; Ko and Dennis 2011). The mixed performance outcomes of KMSs could lie in how employees make use of such systems and, hence, it is important to understand how employees can better use a KMS to enhance job performance. Besides limited research seeking to answer this question, there is even less of an understanding of how KMS use affects job satisfaction. But there is some research that has examined job satisfaction from other perspectives, such as job characteristics (e.g., Morris and Venkatesh 2010) and benefits/risks (e.g., Saatcioglu 2008), in the context of implementations of large-scale information systems (IS). Quite in contrast to IS research, research in organizational behavior has extensively studied job outcomes using different theoretical perspectives, such as social networks (e.g., Cross and Cummings 2004), leadership (e.g., Piccolo and Colquitt 2006), and organizational support (e.g., Rich et al. 2010). However, little organizational behavior research has incorporated the role of technology in understanding job outcomes. This work seeks to integrate both IS and organizational behavior research to gain a better understanding of job outcomes in the context of KMS use.

KMSs are usually complex and incorporate various technologies, with numerous features (e.g., He and Wei 2006). It is very challenging or nearly impossible for employees to leverage all these features. It is believed that employees may get a majority of their job tasks done using a small number of KMS features (e.g., Ghaziri and Awad 2005; Zhang et al. 2011). Therefore, it is important for employees to use the key features that facilitate job outcomes. Research has yet to identify these key KMS features, the drivers of the use of these features, and the effects of the use of these features on job outcomes. Although prior studies have examined various drivers of KMS use at the system level, such as system quality, information quality (Setia et al. 2013; Venkatesh, Thong, and Xu 2016), perceived usefulness (Kulkarni et al. 2006), climate for innovation and autonomy (Durcikova et al. 2011), and social capital (Wasko and Faraj 2005), research on identifying and validating the drivers of KMS use at the feature level is scant. Likewise, although a few studies have examined the effects of certain KMS features, such as the effect of social bookmarking on employee innovativeness (Gray et al. 2011) and the effect of rating on decision performance (Poston and Speier 2005), there is still a lack of research that examines the effects of key KMS features on job performance and job satisfaction. This work seeks to address this gap by identifying key KMS features whose use is critical and building a holistic nomological network around the use of those features.

Leveraging the key KMS features that we identify, we build a nomological network around the use of these features. We theorize how the use of these features affects job outcomes. We examine two job outcomes (i.e., job performance and job satisfaction) and seek to distinguish between features when used that are expected to have a stronger impact on job performance and those that are expected to have a stronger impact on job satisfaction (e.g., Alavi et al. 2005; McAfee 2006). On the antecedents side of our nomological network, in order to identify key drivers of the use of these KMS features, we turn to the prior literature on KMS implementations that mainly categorizes drivers of KMS use into technological, psychological, and social factors (e.g., He et al. 2009; Kankanhalli et al. 2011; Wasko and Faraj 2005). Although these factors provide different mechanisms that explain KMS use, prior research has not fully taken into account the richness of social interactions in explaining KMS use (e.g., Sykes et al. 2011). To help employees overcome knowledge barriers to learning the numerous features of large-scale and complex systems, informal social networks that represent social interactions among employees become a potential solution for employees to overcome barriers to use in general (see Kanter 2000), enterprise systems in particular (e.g., Sykes 2015; Sykes and Venkatesh 2017; Sykes et al. 2009; Sykes et al. 2014) and, more specifically, KMS (e.g., Wasko and Faraj 2005). One important type of informal network that is relevant in the context of the implementations of large-scale ITs is a peer support network that includes both help-seeking ties and help-providing ties (Sykes et al. 2009). Little research, however, has examined the role of a peer support network in facilitating the use of key KMS features and job outcomes. In the context of KMS implementations, peers (coworkers) become an important source to whom employees can turn (e.g., Sykes et al. 2011). A peer support network thus refers to employees' help-seeking and help-providing relationships with coworkers that in turn play an important role in tackling challenges and difficulties arising from KMS use. Given the potential key role of a peer support network in facilitating KMS use, we identify it as a driver of the use of the key KMS features.

In this paper, we seek to answer the following research questions:

(1) What are the key KMS features that enhance job out-

comes? We use a combination of a literature review and a qualitative study to answer this question.

(2) What are the drivers and consequences of use of the key KMS features? We develop and test a model that includes key antecedents (i.e., help-seeking and help-providing ties) and key consequences (i.e., job performance and job satisfaction) of using the key KMS features that were identified. Specifically, we will accomplish this objective by conducting a field study that includes multiple waves of data from multiple sources.

This work is expected to make several theoretical contributions. First, we advance research on KMS by developing a nomological network around KMS use by integrating IS and organizational behavior research. Second, because KMSs are large and complex systems that facilitate collaboration among employees (e.g., He and Wei 2006), our understanding of job outcomes in the context of a KMS implementation should also shed light on our understanding of implementations of large-scale collaborative systems and possibly provide insights into a nomological network around the use of such systems. Third, this work will extend organizational behavior research on job outcomes by explaining how peer support ties directly or indirectly affect job outcomes mediated by technology use (here, KMS use). Finally, a key empirical/methodological contribution of our work to this stream relates to the use of multiple methods, multiple data sources, and collection of data at multiple time periods to provide more robust measurement and a more rigorous empirical test.

The paper is organized as follows. First, we explain our research approach (i.e., a mixed methods approach). Next, drawing on the KMS literature, we identify the key KMS features and then validate these features using a qualitative study. Finally, we incorporate these features into a model that represents the nomological network around the use of the key KMS features and validate the model using a quantitative study.

Key KMS Features

Employing a Mixed Methods Approach

Mixed method research combines quantitative and qualitative research methods in the same research inquiry (for a recent review, see Venkatesh et al. 2013; Venkatesh, Thong, and Xu 2016). As noted earlier, following our literature review that was used to identify key KMS features, we used a qualitative study to identify the key KMS features to incorporate in our model. We used a mixed methods approach because it helps us find theoretically plausible answers to our research questions and provides stronger inferences than a single method. An important issue related to the use of a mixed methods approach is to offer a holistic explanation of the phenomenon by integrating findings from both qualitative and quantitative studies. In order to do so, we can use a concurrent approach that merges qualitative and quantitative findings or a sequential approach that uses findings from one type of study to inform the findings of another type of study. We used a sequential approach given that findings from our qualitative study (i.e., identification of the key KMS features) theoretically inform our quantitative study (i.e., model validation) at a later stage. Such a sequence is appropriate when there is no strong theoretical foundation for a research inquiry (Venkatesh et al. 2013) because a qualitative approach is useful to inductively generate theoretical insights (Punch 1998; Walsham 2006). Given that there is no strong theoretical foundation for *identifying key KMS features* that facilitate job outcomes and there is a lack of research on what these features are, a qualitative study for feature validation, followed by a quantitative study for model validation was deemed to be appropriate.

KMS Features in the KMS Literature

A collaborative system seeks to create a working environment that supports employees in both their individual and collective work (e.g., Easley et al. 2003). Small collaborative systems can be simple software applications, such as e-mail, calendaring or text chat (e.g., Javenpaa and Staples 2000). Large-scale collaborative systems generally incorporate various information and communication technologies, such as database technologies and web technologies, that help employees to complete their job tasks (e.g., He and Wei 2009). Large-scale collaborative systems can provide more comprehensive and sophisticated functionalities, such as multi-user editing tools, cooperative schedulers and calendars, conferencing systems and workflow systems (Grudin 1994; Rai et al. 2010; Tsui 2005). Whereas a small-scale collaborative system mainly facilitates specific aspects of an overall collaborative workflow among a small number of employees, a large-scale collaborative system mainly supports an overall collaborative workflow among a large number of employees. A KMS is an instance of a large-scale collaborative system mainly developed to support professional and managerial activities by focusing on managing knowledge and knowledge resources (Alavi and Leidner 2001). A KMS typically incorporates diverse features to facilitate knowledge exchange, transfer, and application (Alavi and Leidner 2001).

Earlier work on KMSs refers to various forms of systems, including codification-based systems, for example, electronic knowledge repositories (Kankanhalli et al. 2005; O'Dell and

Table 1. Literature Review Summary: KMS Features*

KMS Features	Description	References
Annotate	Capabilities for users to document inputs and analysis for future sharing	Akscyn et al. (1988); Markus et al. (2002)
Assess credibility	Indicate validity of the KMS content	Poston and Speier (2005)
Catalyze discussion	Capabilities to save and e-mail analysis results to others for evaluation and discussion	Markus et al. (2002)
Visualize e-mail	Visualizations of email exchanges over a period of time to show both tasks and social messages	Zhang (2008)
Enter experimental knowledge	Allow employees to enter partial information entries and then make corrections to them at a later time	Majchrzak et al. (2005); Majchrzak et al. (2000); Malhotra et al. (2001); Markus et al. (2002)
Flag expert	Allow domain experts to identify critical changes or advances in specific areas	Jan et al. (2009); Zhang et al. (2011)
Profile expert	Contain a directory of the backgrounds, skills, and expertise of individuals who are knowledgeable on various topics	Alavi and Leidner (2001); Baloh (2007)
Recognize identity	Recognize and preserve the unique identity of a user	Bhatti et al. (2007); Majchrzak et al. (2005); Zhang et al. (2011)
Profile interest	Determine which members might be interested recipients of point-to-point electronic messages exchanged among other members	Alavi and Leidner (2001); O'Dell and Grayson (1998)
Notify	Report knowledge changes to other team members	Chao et al. (2007); Zhang et al. (2011)
Comment	Provide feedback on others' ideas and thoughts	Akscyn et al. (1998); Alavi and Leidner (2001); McAfee (2006); Zhang (2008)
Post	Expression of knowledge, ideas, questions	Akscyn et al. (1998); Alavi et al. (2005); Alavi and Leidner (2001); Baloh (2007); Hsia et al. (2006); Richardson et al. (2006); Zhang (2008)
Rate	Indicate quality of specific KMS content	Poston and Speier (2005)
Search	Locate required knowledge or information	Akscyn et al. (1998); Hsia et al. (2006); Poston and Speier (2005); Revere et al. (2007); Wei et al. (2007); Zhang et al. (2011)
Bookmark	Features that let users assign tags, or self-selected key words, to their bookmarks, and search through their tags and associated bookmarks	Gray et al. (2011)
Syndicate	Summarize relevant topics and display them in one place, thus making it easy for readers to digest information	Cold (2006); Treiber and Dustdar (2007); Zhang et al. (2011)
Play video	Screen includes images of the participants, windows of technical data, video clips of the physical issue under consideration, specifications, contractual data, and plans	Alavi and Leidner (2001); Murray (1998)

*Papers were identified from 1995 to 2012 from journals in EBSCO, ProQuest and Google Scholar; keywords used for the search were related to knowledge management systems (e.g., KMS, Web2.0, Wiki, blog, knowledge repositories).

Grayson 1998), personalization-based systems (Robey et al. 2000), and network-based systems, such as communities of practice (Wasko and Faraj 2005). Recent work on KMSs has expanded this list to include interactive systems that use new social media technologies, such as blogs, wikis, messaging and social blogging, to facilitate knowledge exchange among employees in a more free-flowing and unconstrained manner (McAfee 2005; Ransbotham and Kane 2011). We define a KMS as an IT tool incorporating any combination of the following technologies—knowledge repositories, personalization-based systems, network-based systems, and interactive systems to facilitate organizational learning by capturing and disseminating knowledge (Im and Raven 2003). We focus on examining a KMS with electronic knowledge repositories (e.g., Kankanhalli et al. 2011), personalization-based systems (e.g., Robey et al. 2000), and interactive systems driven by social media technologies (e.g., Secundo and Grippa 2010).[2]

To identify the key KMS features that facilitate job outcomes, we first reviewed prior KMS literature and identified a broad set of features that fulfill various work-related purposes (see Table 1). We expect that use of some of these features, especially those that are more effective in supporting information needs of employees (McAfee 2005) and those that are used more frequently by employees, are likely to contribute positively to job outcomes. Using this list of features, we then conducted a qualitative study to identify the key KMS features. Given that context plays an important role in affecting organizational behaviors (Johns 2006; for an example, see Venkatesh et al. 2010), we used a particular KMS for our study and our approach here is broadly consistent with ideas related to inductive theory building that suggests generalizing the facts obtained from individual members to all members of the class (Locke 2007).

Qualitative Study to Validate KMS Features

The KMS

The KMS being studied was a commercial product mainly used to facilitate organizational learning by capturing and disseminating knowledge. It comprises both knowledge repositories (e.g., library, portal, RSS), personal-based systems (e.g., yellow pages, forums) and interactive systems. The interactive systems use new social media technologies, such as blogs, wikis, messaging, and social blogging, to facilitate knowledge exchange among employees. The KMS incorporates many features and employees mainly used it for knowledge sharing (e.g., using group support systems and intranets with features of blogs and wikis to share knowledge). As noted earlier, network-based systems were excluded because they were not parts of the KMS being studied.

Participants and Data Collection

We conducted interviews with 35 employees. Five employees were chosen from each of seven business units—finance and budgeting, accounting, personnel, customer management, sales, advertising and public relations, and government liaison—of a large organization in the finance industry that implemented the KMS. We conducted the interviews about 4 months after the KMS was implemented by which time the organization had developed a better idea of who the experts were. These 35 interviewees were known for their expertise and proficiency in leveraging the KMS. All interviewees were promised anonymity. With regard to the interview protocol adopted, we used a top-down approach and asked open-ended questions.

Each interview had two parts following the approach of Venkatesh and Brown (2001). In the first part, one of the authors asked questions about the KMS features. The questions were based on our literature review to focus on features that help employees fulfill work-related purposes. Three questions were asked:

(1) Please identify 5 to 10 features you use most frequently to fulfill work-related purposes.

(2) Please illustrate what types of work-related purposes are supported by the features you identified and how such features support work-related purposes.

(3) Please explain why you prefer to use these features but not others.

In the second part, the interviewee filled out a survey to rate the extent to which they agree that each of the KMS features on the list helps them fulfill work-related purposes. A seven-point Likert scale from "strongly disagree" (i.e., 1) to "strongly agree" (i.e., 7) was used. It should be noted that the interviewees did not identify any features that were not already in our list based on our literature review. However, we do note that the qualitative study was still critical as it helped us identify four *key* KMS features. The list served the purpose of helping interviewees recall features that they may have otherwise forgotten and it also helped us check the level of agreement between theory and practice.

[2]We do not examine network-based systems because this component was not included in the KMS being studied.

Table 2. Extent of Agreement on KMS Features that Fulfill Work-Related Purposes

KMS Features	Mean	S.D.
Annotate	4.35	0.75
Assess credibility	4.41	1.28
Catalyze discussion	4.80	1.20
Visualize email	4.51	1.20
Enter experimental knowledge	4.80	1.20
Flag expert	3.98	1.27
Profile expert	4.25	0.85
Recognize identity	4.85	1.25
Profile interest	3.99	1.20
Notify	4.30	1.31
Comment	5.42	.75
Post	5.21	0.95
Rate	5.12	1.02
Search	5.05	0.98
Bookmark	4.88	0.79
Syndicate	4.79	1.32
Play video	4.57	1.01

Each interview lasted between 30 to 60 minutes depending on the number of features the interviewees talked about and the level of details the interviewees provided. All the interviews were tape-recorded and then transcribed by a professional transcriber. The transcription produced nearly 200 pages of single-spaced text.

Data Analysis and Results

Prior to analyzing the interview transcripts, we examined the extent to which interviewees reported that the various features, shown in Table 1, helped employees fulfill work-related purposes. These results are shown in Table 2. It is clear from Table 2 that post, rate, comment, and search were the features with the highest levels of agreement, thus suggesting that these were the key features that fulfill work-related purposes and were likely to impact job outcomes.

We next used Miles and Huberman's (1994) approach to code and analyze the interview data. We examined the transcripts for components representing KMS features (e.g., what the KMS features were, what types of work-related purposes were supported by the features, how the features supported those purposes, and why the interviewees thought the KMS features were important). We identified the most important KMS features by selecting those that were most frequently cited (e.g., Koh et al. 2004).

Table 3 provides a summary of the four KMS features that were most frequently cited—which was consistent with the findings shown earlier in Table 2. Some KMS features were not mentioned by the participants, likely for various reasons. One reason could be that the participants did not think those features were as useful as the four features (i.e., post, rate, comment, and search) to perform work tasks. Another reason could be that those other features were not used frequently such that the participants chose not to talk about them. The third reason could be that a feature was quite similar to another one or it was embedded in another one. For example, the participants may not have discussed the *syndicate* feature because it was embedded in the *search* feature.

The second column of Table 3 indicates at least 25 employees identified each of the four KMS features and the third column indicates at least 20 employees provided the same reason for choosing each of the four KMS features. Given that majority of the participants (i.e., two-thirds of all participants selected the four features and for the same reason, with more than half of the participants giving the same reason), we believe these are the most important features that help employees fulfill work-related purposes. The last column of Table 3 provides example comments from interviewees who explained why a KMS feature is important for work-related purposes. For example, one of the important reasons for employees to choose the post feature was that they thought that the post feature could trigger discussion on a particular topic (e.g., talking

Table 3. Summary of KMS Features

KMS features	Number of interviewees identifying the feature	Number of interviewees providing the same reason for choosing the feature	Example comments from interviewees
Post	28	22	"I like to post information on the system because it could inspire interesting discussion on certain topics. Once I posted something about how to import data from a spreadsheet to the system, it generated a lot of responses. People talked about different ways of doing it, the pros and cons. I remember some people mentioned using one of the methods from the discussion greatly reduced the time it took for them to complete key work tasks…"
Rate	25	20	"I like to use the rating feature of the system because it provides me a way to evaluate the usefulness of an entry in the system. I think if people know others are going to rate their postings, they are more likely to put in things of better quality. I like to rate the topics I am interested in or familiar with and I like to further discuss them with the people who post…"
Comment	30	25	"I like to make comments on others' postings, such as using affirmative or positive comments to encourage my colleagues to share their knowledge. Sometimes I will express my thoughts and ideas, such as suggesting other potential solutions in addition to the ones discussed in the postings or raising concerns about the validity of the solutions…"
Search	32	30	"I enjoy searching for information on the system. Some information is truly useful in resolving problems…"

about solutions to work-related problems). Such discussions sometimes started online and then turned into face-to-face discussions wherein employees further discussed work-related problems with each other.

Following our literature review and qualitative study, we chose *post*, *search*, *comment,* and *rate* as the key KMS features. *Post* and *search* are features that facilitate knowledge exchange among employees and prior research has indicated knowledge exchange, such as knowledge seeking and knowledge providing, contribute positively to job performance (e.g., Cummings 2004). *Comment* and *rate* are features that fulfill employees' needs for defining and representing themselves in a social context (Zhang 2008). These features allow employees to express themselves to achieve better psychological well-being. When employees have opportunities to express themselves and get acknowledged by coworkers for what they have contributed to others' work, they are likely to feel content with their jobs (e.g., Riaz and Haider 2010).

Theory

In this section, we develop the nomological network around the use of the four key KMS features that were identified and validated in the previous section. We first provide definitions of these features and the two job outcomes (i.e., job performance and job satisfaction) that are the dependent variables of interest. We then briefly discuss research on informal social networks that we used to identify the antecedents of KMS feature use. We then present our model and provide the justification for the relationships in the model.

Definitions of Key KMS Features and Job Outcomes

Post is a feature designed to help employees provide knowledge or seek knowledge online (e.g., Alavi et al. 2005; Kankanhalli et al. 2005). *Search* is a feature that helps employees to locate required knowledge (e.g., Revere et al. 2007; Wei et al. 2007). *Comment* is a feature that allows employees to provide feedback to others' ideas and thoughts (e.g., McAfee 2006). *Rate* is a feature that allows employees to evaluate the importance and usefulness of others' ideas and thoughts (e.g., Poston and Speier 2005). The job outcomes that we examine are job performance (i.e., assessment of employees' overall job effectiveness; Kraimer et al. 2005; Welbourne et al. 1998) and job satisfaction (i.e., how content an employee is with his or her job; Morris and Venkatesh 2010).

Social Network Perspective: Peer Support Network

A social network is

> a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the persons involved (Mitchell 1969, p. 2).

Social networks research argues that networks of relationships developed over time can be viewed as resources for social action (Coleman 1988, 1990). These relationships can influence behaviors, such as technology use (e.g., Sykes et al. 2009; Sykes et al. 2011) and knowledge contribution (e.g., Kankanhalli et al. 2005), and behavioral outcomes, such as job outcomes (e.g., Borgatti and Foster 2003), namely job performance (e.g., Cross and Cummings 2004; Sykes 2015; Sykes et al. 2014) and job satisfaction (Sasovova et al. 2010). Together, this suggests that social networks can influence job outcomes both directly and through behaviors.

At the individual-level, the body of work on social networks seeks to understand interpersonal interactions and relationships, and provides analytical tools for studying these relationships (Bowler and Brass 2006; Sykes et al. 2011). Peer support represents one such relationship that includes support providers and support recipients. Such a relationship describes how peer support is offered by support providers to improve the psychological and physical well-being of support recipients (Bacharach et al. 2000).

The concept of peer support is understood using each of the two words (i.e., peer and support). Peers usually refer to coworkers in a work environment and support is "a system of giving and receiving help founded on key principles of respect, shared responsibility, and mutual agreement of what is helpful" (Mead et al. 2001, p. 135). Peer support essentially represents the type of interaction among employees that is different from routine interactions directed by rules and regulations (Bacharach et al. 2000). It is a volitional act of providing assistance to peers (Brief and Motowidlo 1986). Prior research has explained why peer support is beneficial to individuals. First, peer support helps individuals access various resources, such as emotional support, materials and goods, or advice and feedback, that are useful to overcome difficult problems (Solomon 2004). Second, peers offer each other experiential knowledge that is specialized information and perspectives that they obtain from their life or work experiences (Joshi et al. 2007). Such knowledge is particularly useful when peers encounter similar problems (Shubert and Borkman 1994). Third, when individuals interact with peers who have successfully tackled some problems, they are likely to enhance their own sense of self-efficacy in dealing with similar problems (Solomon 2004). Finally, individuals can benefit from helping their peers by acquiring an enhanced sense of self from the social approval received from those helped (Solomon 2004).

The role of peer support has been examined from both a nonsocial network perspective and a social network perspective. From a nonsocial network perspective, prior research indicates peer support mainly enhanced employees' computer self-efficacy and helped them effectively use a new system (Venkatesh and Bala 2008). From a social network perspective, prior research found that a peer support network facilitated the use of large-scale ITs (Sykes et al. 2009) and helped employees improve their job performance (Sykes 2015; Sykes et al. 2014; Sykes and Venkatesh 2017). During a KMS implementation, employees will find such support to be helpful because they will encounter many problems, such as lack of knowledge about how to use certain KMS features or increased stress resulting from using the system. We examine peer support from a social network perspective because this perspective can better describe the richness of social interactions among employees and such interactions are critical for understanding how employees tackle various challenges during a KMS implementation.

Model Development

Figure 1 presents our research model. Our model relates peer support ties to the use of the key KMS features and job outcomes. In addition, we theorize that the use of the key KMS features affects job outcomes.

Peer Support and Use of KMS Features

Post. Given that employees with a large number of help-seeking ties will have more opportunities to interact with their peers through help-seeking, they will likely be affected by the values (e.g., providing knowledge, experience, and emotional, social, or practical help to each other) accepted or highlighted in the peer support networks. They will be likely to accept and conform to such values (Brass et al. 2004; Maruping et al. 2009). We argue that these employees will be more likely to use the post feature because it can be used to realize such values. Employees who have more help-seeking ties will be likely to seek more help from peers. Through help-seeking, these employees are likely to enhance their communication effectiveness (Tiwana 2008). For example, they can develop a better idea of how to phrase complex financial questions and issues concisely and clearly. In addition, questions that are

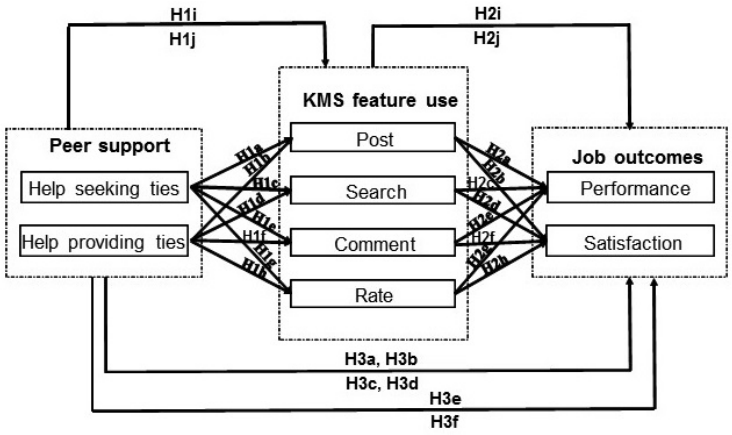


Figure 1. Research Model

easy to understand can stimulate other people to provide answers. An important purpose of the post feature is to let people post questions online. Given that employees who have a large number of help-seeking ties will be likely to know better how to ask questions, it will be easier for them to use the feature to ask questions online. The combination of being able to effectively ask questions and do so easily will contribute to a higher level of use of the post feature. Thus, we hypothesize:

H1a: Help-seeking ties will be positively related to the use of the post feature.

Employees who have a large number of help-providing ties will likely be those who like to help. They will be likely to post knowledge in the system because it could be an efficient way to distribute knowledge or notification (e.g., important policy change in the money market) to a large number of peers. In helping peers, it is important for the employees to clearly articulate or explain the solutions so that their peers can understand. Employees with a large number of help-providing ties have more opportunities to help their peers, thus developing stronger capabilities of articulating or explaining ideas (Dyer and Singh 1998; Tiwana 2008). Another important purpose of the post feature is to facilitate discussion of topics online. Given that employees who have a large number of help-providing ties will be likely to develop stronger capabilities in articulating or explaining ideas and thoughts, it will be easier for them to use the post feature to participate in the discussion of various topics. Consequently, they will be more likely to use the post feature. In addition, compared to those who have a small number of help-providing ties, employees who have a large number of help-providing ties will be likely to have more power and influence due to access to and control of resources (e.g., Ibarra and Andrews 1993; Sykes et al. 2014). When these employees post knowledge or express ideas and thoughts, others will be likely to pay more attention to what they say or react more enthusiastically to the postings by acknowledging the value of the postings or generating more discussion on the topics. If individuals' postings stimulate discussion or are valued, the individuals will be likely to post more. Consequently, we argue that employees who have a large number of help-providing ties will be likely to use the post feature. Thus, we hypothesize:

H1b: Help-providing ties will be positively related to the use of the post feature.

Search. Use of the search feature might pose some challenges to employees. Whereas it may not be difficult to use the search feature to find factual information (e.g., telephone number), it could be quite challenging to obtain answers for unstructured problems (e.g., complex programming problems). This may require more sophisticated and intelligent use of the search feature, such as entering the most relevant and important search keywords, filtering and synthesizing the search results that often have a great deal of irrelevant information, or using different types of search techniques (e.g., federated search that allows the simultaneous search of multiple searchable resources) when necessary. Employees with more help-seeking ties will be likely to develop a better understanding of the search feature with the help of their peers. Assistance from peers can help employees become more familiar with using the KMS, such as seeing the utility of the search feature. For example, employees can observe and learn from their peers who are proficient in using the search feature to explore tips and tricks for improving decision making using financial and risk management tools. This is particularly important with the search feature as its use is

straightforward but leveraging it and using it meaningfully can require tacit knowledge (e.g., keywords to be used, search conditions to be specified). Consequently, employees with more help-seeking ties will be more likely to use the search feature more. Thus, we hypothesize:

H1c: Help-seeking ties will be positively related to the use of the search feature.

People who help others can improve their own skills. For example, prior research indicates that reviewing a peer's paper can enhance a reviewer's own writing skills (Lundstrom and Baker 2009). Along the same line of reasoning, employees will better learn different types of search options and various search techniques through the process of helping others use the search feature. Given that employees with a large number of help-providing ties have more opportunities to help others, these employees will be likely to improve their own skills and experience through the process of helping, such as increasing the speed of search in obtaining a solution to a financial problem. Employees with more help-providing ties may develop better knowledge and skills in using the search feature through the process of helping. They may prefer to use the search feature because they can leverage it more effectively and efficiently. Thus, we hypothesize:

H1d: Help-providing ties will be positively related to the use of the search feature.

Comment. Employees with a large of number of help-seeking ties will be likely to support the values of providing knowledge, experience, and emotional, social or practical help to each other. Such values of helping are particularly emphasized in peer support networks. Using the comment feature, employees can share experiences, provide feedback, or express social and emotional support, all of which are good ways to support the values accepted in the peer support networks. Consequently, we argue that employees with a large number of help-seeking ties will be likely to use the comment feature. The more peer support help-seeking ties employees have, the more likely they will develop a better idea of how to communicate with coworkers through the process of seeking help, such as how to seek help in a polite manner or how to seek help from coworkers without interfering too much with a coworker's work. Making comments requires good communication skills, especially when expressing disagreement. If handled inappropriately, the conversation may become hostile and unproductive. Employees who have better communication skills will be more likely to use the comment feature. Given that employees who have more help-seeking ties are likely to develop a better idea of how to communicate with coworkers (Dyer and Singh 1998; Tiwana 2008), they would be more capable or feel more comfortable using the comment feature. Consequently, they will use the comment feature more frequently. Thus, we hypothesize:

H1e: Help-seeking ties will be positively related to the use of the comment feature.

Consistent with our prior argument on the relationship between help-providing ties and use of the post feature, we argue that employees with a large number of help-providing ties are likely to use the comment feature to provide feedback or express social support because these employees like to help. Along the same line of reasoning mentioned earlier, these employees are likely to have more power and influence (e.g., Ibarra and Andrews 1993; Sykes et al. 2014) such that the comments these employees make are likely to be acknowledged and valued. We argue that such acknowledgement and value recognition will motivate the employees to use the comment feature. As noted earlier, the more peer support help-providing ties employees have, the better they will know how to communicate with coworkers through the process of helping, such as how to explain complex financial solutions to coworkers or how to boost the confidence of coworkers. These employees are likely to feel more comfortable using the comment feature to communicate with coworkers. Consequently, they will use the comment feature more frequently. Thus, we hypothesize:

H1f: Help-providing ties will be positively related to the use of the comment feature.

Rate. Along the same line of reasoning on conforming to and supporting the values accepted in the peer support networks, employees who have a large number of help-seeking ties are likely to use the rate feature as a way to support such values. For example, employees may use the rate feature to show gratitude, especially to peers who have helped them, acknowledge peers' expertise or attract attention to and discussion about the rated postings (e.g., risk analysis in the financial market). They may also use high rating scores to increase peers' visibility. Thus, we hypothesize:

H1g: Help-seeking ties will be positively related to the use of the rate feature.

Employees who have a large number of help-providing ties will likely engage in more social behaviors with respect to giving help (Mead et al. 2001). They like to offer advice and information, and show their compassion and caring. For example, employees can use ratings to show their enthusiasm for others' work or acknowledge the good work done by coworkers. Consequently, employees who have a large number of help-providing ties will be likely to use the rate feature. Thus, we hypothesize:

H1h: Help-providing ties will be positively related to the use of the rate feature.

Competing Effects of Peer Support on Use of KMS Features

We expect the effects of help-seeking ties and help-providing ties on the use of the four KMS features to be fairly similar. On the one hand, employees who have a large number of help-seeking ties could be argued to post less as they could leverage their network for solutions. Similarly, it could be argued that they may rely on their network and use the search feature less. On the other hand, the reason why employees build a large help-seeking network could be because they prefer to seek solutions from different sources. We argue that such employees may therefore want to use the post and search features given that these features may provide an alternative or a complementary approach to obtain solutions. Employees with more help-seeking ties will receive several potential solutions and are thus likely to use the comment and rate features to provide feedback and evaluations on the solutions they have received. Based on the above rationale, we argue that the magnitude of the effects of help-seeking ties on the use of the four features will likely be similar.

H1i: The effects of the help-seeking ties on the use of the four key KMS features (i.e., post, search, comment, and rate) will be similar.

With regard to help-providing ties, employees who have a large number of help-providing ties will be likely to use the post and search features to accumulate knowledge without which they will be less likely to be the sources of knowledge for many other employees. Likewise, employees with more help-providing ties will typically be knowledgeable employees who will be more likely to use the comment and rate features to provide feedback and evaluations. Taken together, we argue that the magnitude of the effects of help-providing ties on use of the four features will likely be the same.

H1j: The effects of the help-providing ties on the use of the four key KMS features (i.e., post, search, comment, and rate) will be similar.

Use of KMS Features and Job Outcomes

Employees can use the post feature to contribute knowledge. Knowledge contribution is seen by peers and supervisors as a good citizenship behavior (e.g., Kankanhalli et al. 2005). Such employees will likely be perceived favorably by their coworkers and supervisors who will be likely to give them better job performance ratings (Diefendorff et al. 2002). Employees can also use the post feature to initiate discussions on work-related problems with coworkers (e.g., Alavi et al. 2005; Kankanhalli et al. 2005). Such discussions help employees develop a better understanding of certain topics and clarify misunderstandings on certain topics (e.g., policies). More importantly, they may learn diverse perspectives from different coworkers that could aid in coming up with a better solution to accomplish their own job tasks. In addition, before employees post, they will be likely to study relevant topics, a process through which employees may learn new materials or find different options to tackle problems. Consequently, they gain a better understanding of a certain topic and strengthen their skills in resolving problems. This will help them better accomplish their jobs. Thus, we hypothesize:

H2a: Use of the post feature will be positively related to job performance.

Most firms will be willing to grant employees flexibility in what they can post, increasing employees' sense of control that has been found to positively affect satisfaction (e.g., Stevens et al. 2012). By posting interesting ideas and thoughts, employees derive satisfaction from seeing their creativity on display (O'Leary 2008). Whereas employees can express their ideas and thoughts in a face-to-face (FTF) setting, using an online post feature may have other advantages, such as reaching a larger audience or having fewer constraints about meeting times and places. In addition, employees may feel more comfortable in expressing ideas and thoughts in an online environment. Employees will likely be satisfied with their jobs if they can express ideas and thoughts freely (e.g., Riaz and Haider 2010). Thus, we hypothesize:

H2b: Use of the post feature will be positively related to job satisfaction.

Search is a feature that helps employees find information or knowledge to resolve work-related problems. Different techniques, for example, document category management (Wei et al. 2007) and contextual information management (Liao et al. 2004), have been applied to facilitate search and retrieval of information. When employees find the information or knowledge (e.g., data of risk market analysis for which they are looking and such information or knowledge helps to get their job tasks done), this will enhance their job performance. By using the search feature, employees not only obtain information or knowledge, they also get to know more about the people who provide the information and knowledge (Kankanhalli et al. 2005; Wasko and Faraj 2005). In other words, employees can develop a better awareness of others' areas of expertise. Prior research has indicated a positive relationship between awareness of other employees' areas of expertise and

job performance (Cross and Cummings 2004) as employees will be able to leverage their awareness over the longer term. Thus, we hypothesize:

H2c: Use of the search feature will be positively related to job performance.

Generally speaking, if people search for something and find what they need, they will likely be satisfied. Specifically, if employees can find information they need for job task completion (e.g., important information about acquisition cost), they will likely be satisfied with their jobs. It is also critical to obtain information or knowledge in a timely fashion. Using the online search feature may increase the speed of obtaining information compared to getting information in an offline context given that digital information can be retrieved and displayed in seconds. In addition, searching information online may allow employees to access a larger pool of information that may provide more options for problem solving (Zhang and Venkatesh 2011). Having more options means more control over one's work, and prior research has indicated a positive relationship between control and job satisfaction (e.g., Lee and Brand 2005). Consequently, employees using the online search feature will likely be satisfied with their jobs. Thus, we hypothesize:

H2d: Use of the search feature will be positively related to job satisfaction.

The fact that employees want to make comments on certain postings indicates their interest in certain topics. Such interest could motivate employees to explore the knowledge domain related to the postings to gain a better understanding of the postings, before making comments. For example, when an investment banker wants to make comments on a posting about diversification of securities, he or she will likely spend some time finding out more information about the solutions discussed in the posting. Consequently, he or she will develop a better understanding of the domain knowledge that may become critical for his or her job task completion. In addition, employees who make many comments will likely be those who like reading postings. By reading the postings, employees may learn the knowledge posted and apply it to accomplish their own work. Thus, we hypothesize:

H2e: Use of the comment feature will be positively related to job performance.

Making comments is a way to express one's ideas and thoughts. It is important that employees can express their ideas and thoughts so as to be seen and acknowledged. When employees make comments, such comments will likely be read by other employees. By reading the content of the comments, employees will be likely to develop perceptions about those who make the comments, such as areas of interest, knowledge level in a certain domain and even their personalities (e.g., Goldman et al. 2008), even though they may never have met each other. The more employees make comments, the more likely they will be recognized, valued, and supported by others, especially for those who provide critical insights to topics being discussed. Consequently, they will be more likely to be satisfied with their jobs. Otherwise, as mentioned earlier, employees may feel isolated for not being part of a "big family," resulting in lower levels of job satisfaction. In addition, the fact that employees want to make comments on certain postings indicates their interest in certain topics. When employees are interested in what they are doing, they will be likely to enjoy the process and be satisfied with what they are doing. Employees may like making comments because it allows them to talk about topics they find to be interesting. As we know, when people engage in a conversation about a topic in which they are truly interested, they can talk for a long time without even realizing how much time has elapsed (see Agarwal and Karahanna 2000). In other words, employees will be likely to derive enjoyment from the process of commenting on job-related topics, which in turn enhances their satisfaction with their jobs. Thus, we hypothesize:

H2f: Use of the comment feature will be positively related to job satisfaction.

It is important for employees to get feedback or evaluation from coworkers because such feedback or evaluation is a good indicator of work quality. Having such information, employees know whether they should make changes to improve their work. The rate feature provides a good way to evaluate work quality. To provide accurate ratings, employees need to have a better understanding of the knowledge or topics being posted. The more an employee provides ratings, the more the employee will be prompted to reflect on his or her knowledge that in turn helps the employee deepen his or her own understanding of the knowledge or topics concerned (e.g., different strategies of stock diversification) that in turn helps the employee perform better. Thus, we hypothesize:

H2g: Use of the rate feature will be positively related to job performance.

The rate feature provides employees an opportunity to judge the quality of others' ideas and thoughts (Poston and Speier 2005). When rating, employees may feel like judges with power and authority. Such a feeling of empowerment will be likely to increase job satisfaction given that prior research has indicated a positive relationship between empowerment and

job satisfaction (e.g., Seibert et al. 2004). Given that providing an accurate assessment of others' ideas and thoughts can help improve the quality of postings and comments, employees will view their roles as raters as creating value for the organization. Employees will likely be satisfied with what they have done if it is valuable because it will enhance their self-image or self-identity (Kankanhalli et al. 2005; Wasko and Faraj 2005). Thus, we hypothesize:

H2h: Use of the rate feature will be positively related to job satisfaction.

Competing Effects of Use of KMS Features on Job Outcomes

The post and search features are more functional-oriented and have clearer emphases on aiding task accomplishment. The comment and rate features could in part be related to emotional purposes, such as expressing emotions, improving psychological well-being, or showing encouragement to coworkers (e.g., Nair and Vohra 2010; Zhang 2008), in addition to task accomplishment. Therefore, we argue that the post and search features are relatively more efficacious for job performance, whereas the comment and rate features are relatively more efficacious for job satisfaction.

Organizations encourage employees to contribute knowledge by using the post feature (e.g., Richardson et al. 2006) and those who use this feature will be perceived more favorably by managers and peers during performance evaluations. Posting knowledge or expertise is generally regarded as a more valuable knowledge contribution behavior than making comments such that managers and peers will likely assign more weight to posting than to making comments during performance evaluation. This will be likely because when making postings, employees either directly contribute knowledge in a certain domain or ask questions that may stimulate thoughts and ideas, potentially resulting in knowledge creation (Alavi and Leidner 2001; McFadyen and Cannella 2004). Consequently, the effect of the post feature on job performance will likely be stronger than the effect of the comment feature. In addition, employees who post knowledge on certain topics generally have a better understanding of the topics than those who make comments on the topics. Most of the time, employees make comments to express some ideas or thoughts related to one or two aspects of certain posted topics without complete comprehension of those topics. In some cases, employees make comments, such as using a few encouraging words, only to be polite and show support for their peers without truly discussing the content of the postings. When knowing such topics is critical for job task completion, we expect the effect of the post feature on job performance will be stronger for employees who post knowledge than for those who make comments. Likewise, in providing ratings, employees may not develop as complete an understanding of the topics as they do when providing postings that require in-depth knowledge of certain topics. Consequently, they will be less likely to leverage knowledge related to these topics to enhance their job performance.

When employees use the search feature to resolve job-task problems, they may get the solutions to their own job tasks quickly (Bell and Ruthven 2004). Likewise, when employees use the post feature to ask questions related to work problems, they may obtain solutions that facilitate their job task completion. But when employees comment on or provide ratings for others' work, they will be likely to directly contribute to others' work and job performance. In addition, if employees spend too much time in making comments or providing ratings, they may divert attention from performing their own job tasks. Therefore, we argue that use of the search feature will have a stronger effect on job performance than use of the comment or rate features. Thus, we hypothesize:

H2i: The effects of the post and search features on job performance will be stronger than the effects of the comment and rate features.

With respect to the magnitude of effects of the four key KMS features on job satisfaction, we argue that the magnitude of effects will be stronger for the comment and rate features than they will be for the post and search features. The comment and rate features may give an employee an empowered feeling of being a "judge" or "commentator," thus leading to a higher job satisfaction (e.g., Hechanova et al. 2006). Given that making comments and providing ratings focus on fulfilling employees' needs for defining and representing themselves in a social context (Zhang 2008), these two features will be likely to have a stronger impact on job satisfaction. These features allow employees to express themselves to achieve better psychological well-being. When employees have opportunities to express themselves and get acknowledged by other coworkers for what they have contributed to others' work, they will be likely to feel content with their jobs (e.g., Riaz and Haider 2010). Prior research indicates a strong correlation between self-expression (i.e., being able to express freely ideas, thoughts, or emotions in organizations, and job satisfaction; e.g., Yang and Chang 2008) and one of the important predictors of alienation from work and job dissatisfaction is inability of work to allow for self-expression (Nair and Vohra 2010). When making comments or providing ratings, employees freely share their points of view, talk about their concerns, or display emotional support, such as giving a high rating or using a thumbs-up sign to indicate support for

coworkers' postings. The more employees use these two features to express themselves, the more likely they will be satisfied with their jobs.

Unlike the comment and rate features that will be more likely to affect individuals' psychological well-being, the post and search features will be more likely to be used for instrumental purposes rather than satisfying psychological well-being. Both the search and post features will be less likely to be used to support self-expression that is strongly related to job satisfaction. The search feature does not afford expression nor the empowered feeling to evaluate others' contributions and, hence, may have a weaker effect on job satisfaction. Whereas the post feature can allow employees to express ideas and thoughts, it is a feature mainly used to display specific knowledge, techniques, or know-how (Alavi et al. 2005). It is an important way for employees to exchange knowledge to aid task accomplishment. We also expect a weaker effect of the post feature on job satisfaction because employees will be more likely to use this feature for task purposes than for emotional purposes. Thus, we hypothesize:

H2j: The effects of the comment and rate features on job satisfaction will be stronger than the effects of the post and search features.

Peer Support and Job Outcomes

Prior research has indicated peer support is an instrumental source that is critical for job effectiveness (Tichy 1981). When coming across work problems, it is easier to seek help and learn from peers. Peers, especially in the same business unit, will be likely to have similar, relevant work experience and business knowledge. Peers may explain things better by referring to similar terminologies or work scenarios, thus facilitating effective knowledge transfer (Joshi et al. 2007; Reagans and McEvily 2003). Peers may have come across similar problems and may have fixed the problems such that they can use their own experience to help others. Help from coworkers could be obtained quickly. For instance, employees can talk to coworkers in the same office, chat with those they meet in the hallway, or call a peer to find answers quickly. When employees gain more help from their coworkers to resolve work-related problems, they will be likely to perform better. Thus, help-seeking ties will be a key way to help employees overcome the challenges, such as knowledge barriers, they face during a KMS implementation. Employees with more help-seeking ties will be likely to overcome challenges often and more easily. Thus, we hypothesize:

H3a: Help-seeking ties will have a positive effect on job performance.

Employees who provide help to coworkers may learn from others' mistakes and improve their own problem-solving skills, resulting in enhanced performance. In addition, managers and coworkers will think that those who often provide assistance to coworkers are good team players and knowledgeable employees. Employees providing more help will be perceived more favorably. Consequently, they may give higher performance ratings to such employees. Thus, we hypothesize:

H3b: Help-providing ties will have a positive effect on job performance.

Peer support will be likely to make employees develop favorable perceptions about the work environment given that employees are helpful to each other. Such favorable perceptions will be likely to minimize the mental fatigue and frustration resulting from learning a complex system (Mumford et al. 1987; Sykes 2015; Sykes et al. 2009), such as a KMS, thus making employees more satisfied with their jobs. If an employee gets help from a coworker to have an important job task done, his or her stress associated with such a task will be reduced, thus making him or her feel less intimidated by the work environment. The employee may thus enjoy his or her work (more than he or she would without such help). Employees with more help-seeking ties will be more likely to be able to leverage such ties when they need them. Thus, we hypothesize:

H3c. Help-seeking ties will have a positive effect on job satisfaction.

Helping coworkers will likely be viewed positively by supervisors and coworkers because such a behavior will likely be seen as a positive contribution to the workplace (e.g., Piccolo and Colquitt 2006). This will be likely to make employees feel valued, which is an important aspect of job satisfaction (Collins 2008). Employees with more help-providing ties will be likely to feel more valued and appreciated. Thus, we hypothesize:

H3d. Help-providing ties will have a positive effect on job satisfaction.

Competing Effects of Peer Support on Job Outcomes

We argue that help-seeking ties will have a stronger effect on job performance than help-providing ties will. This is be-

cause knowledge sought will be likely to aid the completion of the knowledge seekers' job tasks, thus having an immediate/proximal effect on their job performance. Although help-providing can contribute positively to job performance (as argued earlier), the effect will be relatively distal because knowledge acquired from helping others may not be directly or immediately applied to the completion of the knowledge providers' job tasks. In addition, we argue that help-providing ties will have a stronger effect on job satisfaction than help-seeking ties will. Helping others will be more likely to foster positive affective feelings because help-providers' knowledge and competence will be recognized, appreciated, and respected by others. Although help-seeking will also contribute to job satisfaction due to the comfort of being able to do one's job, it will not come with the added affective benefit.

H3e: The effect of help-seeking ties on job performance will be stronger than the effect of help-providing ties.

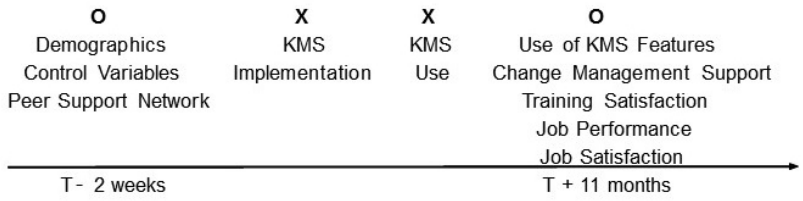
H3f: The effect of help-providing ties on job satisfaction will be stronger than the effect of help-seeking ties.

Model Validation: Quantitative Study

Participants and Data Collection

We collected data from the same organization where we conducted the qualitative study. Data were collected from the same seven business units (i.e., finance and budgeting, accounting, personnel, customer management, sales, advertising and public relations, and government liaison) that we used in the qualitative study. We used both web-based and paper surveys to collect the data so that participants could choose either approach. The surveys were identical other than the media used. We did not find systematic differences in the demographics or the descriptive statistics of the core constructs across these two methods. Among all the respondents, 55% of them chose the online method. The sampling frame was a list of 1,757 employees from these 7 business units who were in similar positions of the organizational hierarchy. They were knowledge workers targeted to benefit from the KMS implementation. Of these, 1,441 provided usable responses, resulting in a response rate of 82%. Network data were collected within each business unit, with approximately 200 employees in each business unit. We did not collect cross-unit network data because domain-specific knowledge sharing is likely to mainly happen within each unit. Further, there is a practical constraint for collecting cross-unit network data as such a survey could become overly long—as it is, our survey already had about 500 questions with approximately 400 of those being the network questions. This approach of using the business unit as the boundary is consistent with other recent social network research (Sykes 2015; Sykes and Venkatesh 2017; Sykes et al. 2014). The response rate in each unit was above 80%, which is above threshold required for social network analysis (Kleiner 2002; Lesser and Prusak 2004). Given that the top management of the company was very interested in this study, they strongly supported our data collection, thus resulting in the high response rate. To assess non-response bias, the demographic characteristics of respondents and non-respondents were compared, and no significant differences were found.

The time line of the data collection is shown in Figure 2. We collected individuals' demographic variables (e.g., age and gender) and other control variables (e.g., computer experience, computer self-efficacy, conscientiousness, and expertise) two weeks before the KMS implementation. Given that we examine how peer support network affects KMS use, we needed to collect peer support network data prior to KMS use and we collected the data in conjunction with the demographic and other control variables. To collect the peer support network data, we requested employees to fill out the survey about two weeks before the KMS implementation. It took about a month for the participants to fill out the network survey and most of them filled out the survey in the early phase of the KMS implementation. According to prior research (Markus and Tanis 2000), in the early phase of a large-scale IT implementation, employees will encounter more challenges and difficulties in using the systems (e.g., Morris and Venkatesh 2010; Sykes et al. 2014) and peer support becomes more critical for employees to tackle various problems (see Sykes 2015; Sykes and Venkatesh 2017; Sykes et al. 2014). The point of measurement of network data is a challenging one and rife with tradeoffs. On the one hand, early measures will be likely to indicate who employees will turn to soon after the system goes live. This will be valuable because that phase is crucial (see Markus and Tanis 2000; Morris and Venkatesh 2010). Such a measurement is consistent with prior network research (see Sykes and Venkatesh 2017; Sykes et al. 2014). But, such a network could change. A later measurement, say a few weeks later, may reveal the "new" network but comes with two problems: first, due to the major system implementation, the response rate will likely to be low given employees are otherwise occupied by the system-related challenges and may have less free time; and second, such a measurement misses all the early network ties that could be relevant. Ultimately, given the tradeoffs, consistent with prior research, we collected the network data to coincide with the go-live.



Notes:
1. O's indicate different data collection points.
2. X's indicate different phases of the KMS implementation.

Figure 2. Data Collection Schedule

To rule out the effects of training and organizational support on job outcomes, we control for training satisfaction and change management support (Venkatesh et al. 2011). Training satisfaction, change management, use of KMS features, job performance and job satisfaction were collected six months after the KMS implementation. Prior research (Morris and Venkatesh 2010) suggests that there will be a shakedown phase for implementations of large-scale information systems and it takes a few months (it could vary across firms and systems) before the use of the new system stabilizes. We picked six months because we learned from the help desk of the company that by the fifth month, the average number of requests for resolving technical problems had significantly reduced, indicating the use of the system had become stable. Job performance and job satisfaction data were collected to coincide with when the company conducted its annual performance evaluations. The 360-degree methodology was used to collect job performance data. Specifically, employees' job performance was evaluated by their supervisors, peers, subordinates, and employees themselves. When employees evaluated their own performance, they also filled out a satisfaction survey.

The organization hired an external firm to process the employees' job performance and job satisfaction data. Once the organization collected the job performance and job satisfaction data, the organization sent it to the external firm which then processed the data to protect personal information. We worked directly with the external firm to obtain the job performance and job satisfaction data. Once we matched the performance and satisfaction data with our survey data, we removed the employees' names to protect their privacy and confidentiality. Participants were allowed to fill out the survey during normal business hours and they returned the completed survey within four weeks upon receipt of the survey. The average time to fill out the social network survey was about one hour. To increase the response rate, we sent a follow-up email once a week for three weeks to those who did not return the completed survey.

Social Network Analysis

According to the social network perspective, the pattern of interaction among people is represented as graph of connections among them (Newman 2002). Within a network, individual actors are called nodes and relationships between actors are called ties. To collect social network data, we used a roster-based approach that employs a fixed contact roster to ask respondents to describe their relationship with each individual on the roster (Wasserman and Faust 1994). Consistent with prior research, social network variables are measured using one item to avoid creating too much work for the respondents and to increase the response rate (Venkataramani and Dalal 2007). For a specific individual, we not only capture the number of peer support ties he or she has, but also the strength of those ties. The social network data were stored in the form of a matrix in which each cell represented the response of person A (in row X) to person B (in column Y). The social network data were then analyzed using UCINET version 6.29 (Borgatti et al. 2002), a commonly used social network analysis program, to compute the network variables.

Measurement

The items used in our study are shown in Table 4. Below, we provide the details.

KMS Feature Use

We obtained data about the use of each KMS feature from system logs about 6 months after the KMS implementation. Counts of the number of postings, searches, comments, and ratings were generated. Such frequency counts as a measure of use is commonly used in the IS literature (for a review, see Venkatesh et al. 2008).

Table 4. Construct and Measures

Constructs	Items										Notes
Peer support	Please indicate how often you interact with the various individuals on the list for help during the implementation of KMS (1 = Never, 5 = Very frequently)										adapted from Borgatti and Cross 2003; Cross and Cummings 2004
		Please indicate the employees below that you typically turn to for help for valued resources, such as task advice, strategic information, social support, during the implementation of the KMS					Please indicate the employees below that typically turn to you for help for valued resources, such as task advice, strategic information, social support, during the implementation of the KMS				
	Name 1	1	2	3	4	5	1	2	3	4	5
	:::::::										
	Name N	1	2	3	4	5	1	2	3	4	5
Use of KMS features	Post: counts of the number of postings.										adapted from Straub et al. 1995; Venkatesh et al. 2008
	Rate: counts of the number of ratings.										
	Comment: counts of the number of comments.										
	Search: counts of the number of searches.										
Job performance	Please rate <individual> along the following dimensions…										7-point Likert scale; adapted from Kraimer et al. 2005; Welbourne et al. 1998
	Quality of work.										
	Quantity of work.										
	Technical competence.										
	Working as part of a team or work group.										
	Help others when it is not part of his/her job.										
Job satisfaction	Overall, I am satisfied with my job.										7-point Likert scale; Morris and Venkatesh 2010
	I would prefer another, more ideal job. (reverse coded)										
	I am satisfied with the important aspects of my job.										
Perceived ease of use	Using the system to find knowledge takes too much time. (reverse coded)										7-point Likert scale; Bock et al. 2006
	Using the system to locate knowledge requires lot of effort. (reverse coded)										
	Using the system to find knowledge is laborious. (reverse coded)										
	I need to think hard to analyze search results. (reverse coded)										
Perceived usefulness	Using the system increases performance.										7-point Likert scale; Bock et al. 2006
	Using the system enables quicker task accomplishment.										
	Using the system enhances effectiveness.										
Loss of knowledge power	Sharing my knowledge through the system makes me lose my unique value in the organization.										7-point Likert scale; Kankanhalli et al. 2005
	Sharing my knowledge through the system makes me lose my power base in the organization.										
	Sharing my knowledge through the system makes me lose my knowledge that makes me stand out with respect to others.										
	Sharing my knowledge through the system makes me lose my knowledge that no one else has.										
Codification effort	I do not have the time to enter my knowledge into the system.										7-point Likert scale; Kankanhalli et al. 2005
	It is laborious to codify my knowledge into the system.										
	The effort is high for me to codify my knowledge into the system.										

Table 4. Construct and Measures (Continued)

Constructs	Items	Notes
Organizational reward	It is important to be promoted when I share my knowledge through the system.	7-point Likert scale; Kankanhalli et al. 2005
	It is important to get a higher salary when I share my knowledge through the system.	
	It is important to get a higher bonus when I share my knowledge through the system.	
	It is important to get a more job security when I share my knowledge through the system.	
Image	People in the organization who share their knowledge through the system have more prestige than those who do not.	7-point Likert scale; Kankanhalli et al. 2005
	Sharing my knowledge through the system improves others recognition of me.	
	When I share my knowledge through the system, the people I work with respect me.	
	When I share my knowledge through the system, my superiors praise me.	
Reciprocity	When I share my knowledge through the system, I expect somebody to respond when I am in need.	7-point Likert scale; Kankanhalli et al. 2005
	When I contribute knowledge to the system, I expect to get back knowledge when I need it.	
	When I share my knowledge through the system, I believe that my questions for knowledge will be answered in future.	
Knowledge self-efficacy	I have confidence in my ability to provide knowledge that others in my organization consider valuable.	7-point Likert scale; Kankanhalli et al. 2005
	I have the expertise needed to provide valuable knowledge for my organization.	
	It doesn't really make any difference whether I add to the knowledge others are likely to share through the system.	
	Most other employees can provide more valuable knowledge than I can.	
Enjoyment in helping others	I enjoy sharing my knowledge with others through the system.	7-point Likert scale; Kankanhalli et al. 2005
	I enjoy helping others by sharing my knowledge through the system.	
	It feels good to help someone else by sharing my knowledge through the system.	
	Sharing my knowledge with others through the system gives me pleasure.	
Trust	I believe that people in my unit do not use unauthorized knowledge.	7-point Likert scale; Kankanhalli et al. 2005
	I believe that people in my unit use other's knowledge appropriately.	
	I believe that people in my unit share the best knowledge that they have.	
Conscientious ness	I…	7-point Likert scale; Gosling et al. 2003
	am always prepared.	
	pay attention to details.	
	make plans and stick to them.	
	waste my time (reversed coded).	
	find it difficult to get down to work (reversed coded).	
Computer self-efficacy	I could complete a job or task using the system…	7-point Likert scale; Venkatesh et al. 2003
	If there was no one around to tell me what to do as I go.	
	If I could call someone for help if I got stuck (reversed coded).	
	If I had a lot of time to complete the job for which the software was provided (reversed coded).	
	If I had just the built-in help facility for assistance.	
Change management support	The change management support was available whenever I needed it.	7-point Likert scale; Venkatesh et al. 2011
	The change management consultants understood my problems well.	
	The change management consultants resolved the problems I faced.	

Table 4. Construct and Measures (Continued)

Constructs	Items	Notes
Training satisfaction	Overall, I was satisfied with the training.	7-point Likert scale; Venkatesh et al. 2011
	The training provided comprehensive coverage of the system and how I would use it in my job.	
	The training materials were comprehensive.	
Expertise	Please rate your subordinates' overall expertise on a 100-point scale with 100 refers to the highest level of expertise:	adapted from Faraj and Sproull 2000; Shanteau 1992
Rank	Which of the following best describes your position in this company: 1. junior manager 2. middle manager 3. senior manager 4. non-managerial employee	Mehra et al. 2001
Tenure	Please indicate the number of years you have been working for this company:__	Cross and Cummings 2004; Mehra et al. 2001
Gender	Male ☐ Female ☐	Cross and Cummings 2004; Mehra et al. 2001
Computer experience	Please indicate amount of computer experience you have in years:__	Venkatesh et al. 2003

Peer Support Ties

Consistent with our theory, the concept of peer support was treated as two constructs: help-seeking ties and help-providing ties (e.g., Sykes et al. 2009). Help-seeking ties and help-providing ties were each operationalized as a formative construct to include both number of ties and strength of ties. If an employee has 10 contacts, he or she may interact with each of these 10 contacts and develop 10 possible relationships with different strengths in terms of peer support. For instance, employee A may form two relationships, one with employee B and one with employee C but the strength of these two relationships may be different in that A may get more help from B than he or she may get from C. Given that prior research has shown that frequency of interaction can be used as a proxy for tie strength (Granovetter 1983; Krackhardt 1992), tie strength was measured as frequency of interaction (1 = never to 5 = very frequently). Both help-seeking ties and help-providing ties were each calculated as the multiplication of the respective number of ties (help-seeking and help-providing) and strength of ties (help-seeking and help-providing), that is, the combined strength of ties (help-seeking and help-providing) an individual had.

Job Performance and Job Satisfaction

Job performance was measured using the 360-degree methodology. This methodology is commonly used in today's organizations to prevent bias and gain a more accurate assessment of employee performance. Job performance was modeled as a second-order formative construct, with both first-order and second-order formative dimensions. The first-order formative dimension represents multiple raters who provide ratings on the five second-order performance indicators (see Petter et al. 2007) adapted from prior research (e.g., Kraimer et al. 2005; Welbourne et al. 1998) to focus on overall job effectiveness. The data were gathered from each employee's supervisor, peer coworkers identified as those who within the past year worked in the same group or worked on the same project as the focal employee, subordinates, and the employees themselves. The number of raters for each employee could vary. The multiple evaluators' ratings on these five items were on a seven-point scale, where 7 was excellent and 1 was very poor. Job satisfaction was measured using a three-item scale (Morris and Venkatesh 2010).

Control Variables

Prior studies have used the same control variables, such as age, gender, and organizational tenure, for both job performance and job satisfaction (e.g., Janssen 2001; Janssen and van Yperen 2004). The control variables for job outcomes were gender (coded as men = 0), computer self-efficacy (items 2 and 3 were reverse coded), computer experience, organizational tenure, rank, expertise, conscientiousness, training satisfaction, and change management support. Gender, organizational tenure, rank, and expertise have been included in prior research that examines individual performance (e.g., Cross and Cummings 2004; Faraj and Sproull 2000) and job satisfaction (Morris and Venkatesh 2010; Pil

and Leana 2009). We asked supervisors to rate the level of overall expertise of their subordinates on a seven-point scale, with reference to their specific functional areas (e.g., customer relationship management, financial planning, sales forecasting). Likewise, conscientiousness was included because this personality trait is a consistent predictor of individual performance (Tett and Burnett 2003) and job satisfaction (Judge et al. 2002). Conscientiousness was measured on a seven-point scale using a short (five-item) version adapted from Gosling et al. (2003). Items 4 and 5 of the conscientiousness scale were reverse coded. We also included satisfaction with training and change management support as controls for job performance and job satisfaction (Venkatesh et al. 2011).

We also included various control variables in the prediction of KMS use. We based our selection of the control variables on two criteria. First, we paid particular attention to the literature that studied an interactive KMS because the four key KMS features will likely be available in such a system. Second, we did not include all variables because some of them have a large degree of overlap (e.g., usability and usefulness, structural capital, and number of ties). The list of control variables included perceived ease of use (Bock et al. 2006; He et al. 2009) and perceived usefulness (He et al. 2009), loss of knowledge power (Kankanhalli et al. 2005), codification effort (Kankanhalli et al. 2005), organizational reward (Kankanhalli et al. 2005), image (Kankanhalli et al. 2005), reciprocity (Kankanhalli et al. 2005), knowledge self-efficacy (Kankanhalli et al. 2005), enjoyment in helping others (Kankanhalli et al. 2005), and trust (Kankanhalli et al. 2005).

Results

We used partial least squares (PLS) to estimate the model because it is a structural equation modeling technique less constrained by residual distributions and well-suited for model testing (Chin 1998a, 1998b; Gefen et al. 2011; Lohmöller 1989). The specific software package we used was Smart-PLS 2.0 (Ringle et al. 2005). In estimating the model, PLS uses a component-based approach designed to maximize the variance explained by the structural model (Chin 1998b). Another reason for using PLS, instead of covariance-based techniques such as LISREL, is because it is particularly well-suited for modeling formative constructs (Chin 1998a, 1998b; Gefen et al. 2011; Lohmöller 1989). Formative measurement poses challenges for covariance-based techniques (e.g., identification of estimates can be more difficult compared to PLS; Cenfetelli and Bassellier 2009). The number of bootstrap iterations used for significance testing was 1,000 (Mooney and Duval 1993).

Measurement Model Testing

To assess the psychometric properties of the multi-item scales with reflective indicators (i.e., computer self-efficacy, conscientiousness, change management support, training satisfaction, and job satisfaction), we conducted confirmatory factor analysis to examine item loadings and cross-loadings, internal consistency reliabilities, and average variance extracted (AVE). Reliabilities, AVEs, descriptive statistics, and inter-construct correlations of the different scales are presented in Table 5. Factor loadings are shown in the appendix. Results supported convergent and discriminant validity as all loadings were greater than .70 and all cross-loadings were lower than the loadings (Fornell and Larcker 1981; Nunnally 1978).[3] The validity of the scales was further supported as all square-roots of AVEs (average variance extracted) were greater than inter-construct correlations. We specified formative constructs by conforming to the guidelines discussed in Petter et al. (2007). We found that the formative indicators account for 48% of the variance in help-seeking and 53% of the variance in help-providing. The weights of number of ties and strength of ties on help-seeking were .35 and .41 respectively, the weights of number of ties and strength of ties on help-providing were .40 and .44, and all weights were significant. The 5 second-order formative indicators accounted for 71% of variance in performance, with all weights being significant and varying from .25 to .38. Consistent with expectations, many positive and significant correlations were found (e.g., help-seeking and help-providing ties and use of KMS features, use of KMS features and job performance, use of KMS features and job satisfaction, help-seeking and help-providing ties and job performance, and help-seeking and help-providing ties and job satisfaction).

Structural Model Testing

The results are shown in Table 6 and Figure 3. Hypothesis 1 theorized the effect of help-seeking and help-providing ties on KMS feature use. The control variables only model explained 22%, 17%, 20%, and 15% of the variance in post, search, comment, and rate, respectively. Adding help-seeking and help-providing ties explained 29%, 25%, 25%, and 22% of the variance in post, search, comment, and rate respectively. Help-seeking ties ($\beta = .16$, $p < .01$) and help-providing ties ($\beta = .17$, $p < .01$) were positively related to post, thus supporting H1a and H1b. Help-seeking ties ($\beta = .19$, $p < .01$) and help-providing ties ($\beta = .22$, $p < .001$) were positively related to search, thus supporting H1c and H1d. Help-seeking ties ($\beta = .14$, $p < .05$) and help-providing ties ($\beta = .13$, $p < .05$) were

[3] It should be noted that in PLS, unlike traditional factor analysis, the rule of thumb is that validity is established when the loadings are greater than cross-loadings (for a recent example, see Siponen and Vance 2010).

Table 5. Descriptive Statistics and Correlations

	Mean	SD	ICR	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Help-seeking ties	4.09	1.81	NA	NA													
2. Help-providing ties	4.24	1.55	NA	.19**	NA												
3. Post	21.08	10.50	NA	.15*	.17**	NA											
4. Search	33.50	13.67	NA	.15*	.12*	.21***	NA										
5. Comment	17.10	6.31	NA	.20***	.14*	.24***	.19**	NA									
6. Rate	15.50	9.41	NA	.18**	.20***	.17**	.21***	.20***	NA								
7. Age	38.55	7.76	NA	.17**	.17**	-.13*	.05	-.16**	-.15*	NA							
8. Gender (0: men)	.27	.44	NA	.05	.10	-.16**	.08	-.15*	-.23***	.02	NA						
9. Tenure	4.45	1.20	NA	.19**	.20***	-.12*	.03	-.14*	-.14*	.24***	-.15*	NA					
10. Rank (grades 1 to 4)	7.78	4.40	NA	.05	.02	-.10	-.02	-.07	.14*	.23***	-.17**	.24***	NA				
11. Computer experience	12.40	6.80	NA	.04	.07	.13*	.17**	.15*	.12*	.07	-.13*	.05	-.10	NA			
12. Computer self-efficacy	4.15	2.12	.80	.04	.10	.15*	.20***	.17**	.10	-.16**	-.24***	-.16*	-.13*	.23***	.75		
13. Conscientiousness	5.30	0.87	.82	.16**	-.13*	.12*	.14*	.14*	.14*	.13*	.08	.14*	.08	.07	.04	.73	
14. Expertise	4.07	1.02	.75	-.10	.13*	.14*	.10	.07	.10	-.10	-.10	.04	.08	.05	.14*	.04	.75
15. Change management support	4.28	1.07	.77	-.17**	.12	.16**	.10	.13*	.07	-.13*	-.10	.02	-.10	.14*	.19**	.10	.02
16. Training satisfaction	4.31	1.05	.84	-.15*	.13*	.17**	.17**	.14*	.08	-.10*	-.07	.05	-.07	.17**	.23***	.07	.07
17. Perceived ease of use	4.10	1.65	.88	.16**	.20**	.12*	.17**	.10	.13*	-.13*	-.15*	.14*	.08	.29***	.23***	.08	.10
18. Perceived usefulness	4.44	1.57	.85	.20**	.17**	.20**	.20**	.17**	.18**	-.16**	-.14*	-.17**	.10	.19**	.24***	.05	.05
19. Loss of knowledge power	4.07	1.60	.76	.13*	.21***	.23***	.20**	.19**	.20**	.10	.07	.10*	.13*	.10	.12*	.13*	.06
20. Codification effort	4.13	1.61	.72	.19**	.23***	-.15*	.12*	.13*	.16**	.08	.05	.10	.07	.10	.13*	.14*	.16**
21. Organizational reward	4.01	1.25	.71	.12*	.13*	.10	.12*	.13*	.12*	.13*	.10	.15*	.10	.12*	.04	.13*	.12*
22. Image	4.28	1.44	.80	.10	.04	.07	.15*	.14*	.10	.08	.08	.10	.05	.06	.10	.07	.05
23. Reciprocity	4.64	1.29	.84	.07	.06	.17**	.10	.07	.10	.15*	.10	.17**	.03	.04	.20**	.02	.03
24. Knowledge self-efficacy	4.00	1.28	.73	.18**	.10	.10	.12*	.13*	.19**	.06	.07	.08	.01	.04	.16**	.02	.03
25. Enjoyment in helping others	3.75	1.35	.77	.12*	.20**	.13*	.13*	.23***	.14*	.19**	.20**	.20**	.21***	.05	.14*	.13*	.12*
26. Trust	4.11	1.28	.74	.15*	.17**	.13*	.07	.17**	.07	.12*	.13*	.05	.06	.04	.10	.13*	.06
27. Job performance	4.92	1.65	NA	.26***	.26***	.15*	.13*	.19**	.17**	.13*	-.07	.15*	.14*	.05	.03	.20**	.03
28. Job satisfaction	4.12	1.53	.79	.21***	.24***	.19**	.15*	.19**	.21***	.17**	.12*	.17**	.13*	.01	.03	.15*	.03

	15	16	17	18	19	20	21	22	23	24	25	26	27	28
15. Change management support	.71													
16. Training satisfaction	.13*	.74												
17. Perceived ease of use	.12*	.15*	.77											
18. Perceived usefulness	.14*	.17**	.22***	.75										
19. Loss of knowledge power	.05	.02	.10	.12*	.73									
20. Codification effort	.07	.08	.13*	.07	.05	.75								
21. Organizational reward	.06	.03	.01	.10	.13*	.14*	.73							
22. Image	.04	.02	.10	.13*	.12*	.19**	.10	.79						
23. Reciprocity	.04	.06	.08	.10	.02	.10	.07	.05	.72					
24. Knowledge self-efficacy	.07	.10	.12*	.14*	.05	.10	.10	.07	.10	.70				
25. Enjoyment in helping others	.04	.05	.06	.10	.13*	.19**	.19**	.07	.04	.03	.75			
26. Trust	.10	.12*	.14*	.13*	.12*	.15*	.17**	.10	.17**	.02	.01	.73		
27. Job performance	.16**	.14*	.07	.17**	.10	.08	.12*	.17**	.08	.10	.07	.05	NA	
28. Job satisfaction	.16**	.19**	.04	.02	.07	.10	.13*	.03	.10	.14*	.13*	.17**	.30***	.77

Notes:

1. n = 1,441.
2. ICR: Internal consistency reliability.
3. Diagonal elements are the square root of the shared variance between the constructs and their measures.
4. *p < .05; **p < .01; ***p < .001.

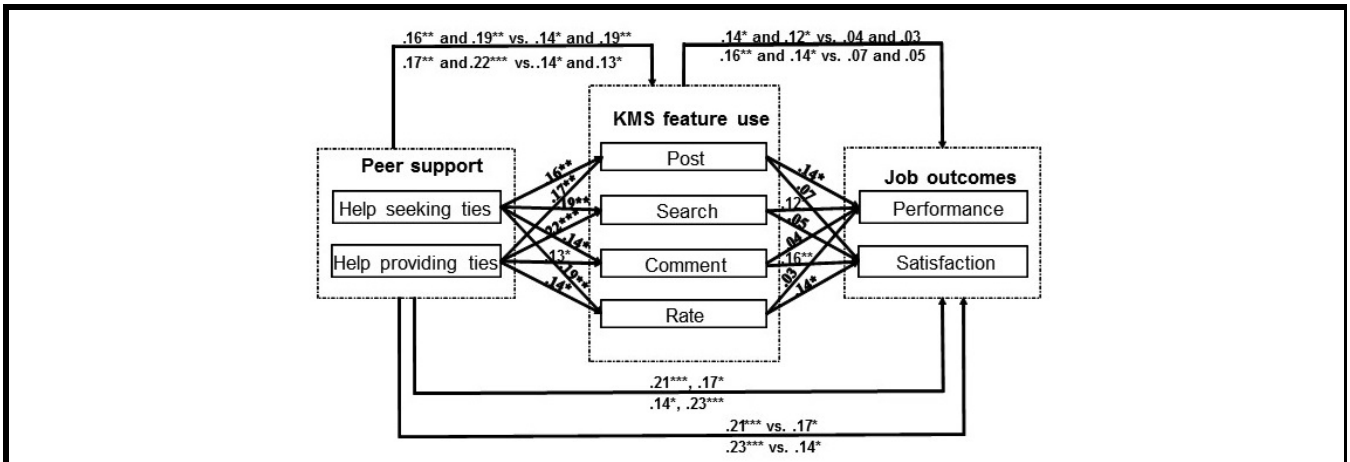


Figure 3. Results of Model Testing

Table 6. Structural Model Results

	Use of KMS features								Job outcomes			
	Post		Comment		Rate		Search		Job performance		Job satisfaction	
R^2	.22	.29	.20	.25	.15	.22	.17	.25	.16	.31	.13	.33
ΔR^2	—	.07**		.05*		.07**		.08***		.15***		.20***
Main effects												
Help-seeking	—	.16**	—	.14*	—	.19**	—	.19**	—	.21***	—	.14*
Help-providing	—	.17**	—	.13*	—	.14*	—	.22***	—	.17**	—	.23***
Post	—	—	—	—	—	—	—	—	—	.14*	—	.07
Search	—	—	—	—	—	—	—	—	—	.12*	—	.05
Comment	—	—	—	—	—	—	—	—	—	.04	—	.16**
Rate	—	—	—	—	—	—	—	—	—	.03	—	.14*
Control variables												
Age	—	—	—	—	—	—	—	—	.07	.05	.12*	.08
Gender (0: men)	—	—	—	—	—	—	—	—	-.11*	-.10	.06	.02
Tenure	—	—	—	—	—	—	—	—	.13*	.11*	.04	.02
Rank	—	—	—	—	—	—	—	—	.04	.02	.06	.04
Computer experience	—	—	—	—	—	—	—	—	.02	.02	.02	.01
Computer self-efficacy	—	—	—	—	—	—	—	—	.02	.00	.02	.01
Conscientiousness	—	—	—	—	—	—	—	—	.16**	.14*	.12*	.07
Expertise	—	—	—	—	—	—	—	—	.05	.02	.07	.05
Change mgt. support	—	—	—	—	—	—	—	—	.12*	.06	.11*	.07
Training satisfaction	—	—	—	—	—	—	—	—	.13*	.10	.14*	.11*
Perceived ease of use	.04	.03	.08	.06	.07	.05	.16**	.13**	—	—	—	—
Perceived usefulness	.19**	.14*	.17**	.14*	.16**	.14*	.24***	.17**	—	—	—	—
Loss of knowledge power	-.19**	-.15*	.14*	.11*	.08	.05	.08	.05	—	—	—	—
Codification effort	-.14*	-.11*	.08	.05	.08	.06	.05	.03	—	—	—	—
Organizational reward	.08	.06	.08	.05	.05	.04	.06	.04	—	—	—	—
Image	.07	.04	.06	.04	.06	.05	.08	.05	—	—	—	—
Reciprocity	.14*	.11*	.05	.03	.05	.04	.05	.03	—	—	—	—
Knowledge self-efficacy	.11*	.07	.17**	.14*	.04	.03	.07	.06	—	—	—	—
Enjoyment in helping	.13*	.11*	.16**	.14*	.09	.07	.05	.04	—	—	—	—
Trust	.14*	.11*	.07	.05	.08	.05	.08	.04	—	—	—	—

Note: *p < .05; **p < .01; ***p < .001.

positively related to comment, thus supporting H1e and H1f. Help-seeking ties ($\beta = .19$, $p < .01$) and help-providing ties ($\beta = .14$, $p < .05$) were positively related to rate, thus supporting H1g and H1h. H1i and H1j theorized that the effects of both help-seeking and help-providing ties on the use of the four key KMS features would be similar. Based on a series of t-tests using bootstrapping that examined beta differences, we found that the effects of help-seeking ties on post ($\beta = .16$, $p < .01$), search ($\beta = .19$, $p < .01$), comment ($\beta = .14$, $p < .05$) and rate ($\beta = .19$, $p < .01$) were similar, thus supporting H1i. However, H1j was not supported because help-providing ties had a stronger effect on post ($\beta = .17$, $p < .01$) and search ($\beta = .22$, $p < .001$) than on comment ($\beta = .13$, $p < .05$) and rate ($\beta = .14$, $p < .05$).

Hypothesis 2 theorized the effect of key KMS feature use on job outcomes. Post was positively related to job performance ($\beta = .14$, $p < .05$), thus supporting hypothesis 2a. Hypothesis 2b was not supported because post was not significantly related to job satisfaction ($\beta = .07$, $p > .05$). Search was positively related to job performance ($\beta = .12$, $p < .05$), thus supporting H2c. H2d was not supported because search was not significantly related to job satisfaction ($\beta = .05$, $p > .05$). H2e was not supported because comment was not significantly related to job performance ($\beta = .04$, $p > .05$). Comment was positively related to job satisfaction ($\beta = .16$, $p < .01$), thus supporting H2f. H2g was not supported because rating was not significantly related to job performance ($\beta = .03$, $p > .05$). Rate was positively related to job satisfaction ($\beta = .14$, $p < .05$), thus supporting H2h. To test the competing effects' hypotheses (i.e., H2i and H2j), we compared the magnitude of the effects of the four KMS features on both job outcomes using a series of t-tests and we found that post ($\beta = .14$, $p < .05$) and search ($\beta = .12$, $p < .05$) had a stronger impact on job performance than comment ($\beta = .04$, $p > .05$) and rate ($\beta = .03$, $p > .05$) did, thus supporting H2i. Likewise, we found that comment ($\beta = .16$, $p < .01$) and rate ($\beta = .14$, $p < .05$) had a stronger effect on job satisfaction than post ($\beta = .07$, $p > .05$) and search ($\beta = .04$, $p > .05$) did, thus supporting H2j.[4]

Hypothesis 3 theorized the effect of help-seeking ties and help-providing ties on job outcomes. Help-seeking ties ($\beta = .21$, $p < .001$) and help-providing ties ($\beta = .17$, $p < .01$) were positively related to job performance, thus supporting H3a and H3b. Similarly, help-seeking ties ($\beta = .14$, $p < .05$) and help-providing ties ($\beta = .23$, $p < .001$) were positively related to job satisfaction, thus supporting H3c and H3d. H3e and H3f theorized that the effect of help-seeking ties on job performance and help-providing ties on job satisfaction will be stronger. Based on a series of t-tests using bootstrapping that examined beta differences, we found that help-seeking ties ($\beta = .21$, $p < .001$) had a stronger effect on job performance than help-providing ties ($\beta = .17$, $p < .01$) did, thus supporting H3e. Likewise, we found that help-providing ties ($\beta = .23$, $p < .001$) had a stronger effect on job satisfaction than help-seeking ties ($\beta = .14$, $p < .05$) did, thus supporting H3f.

Discussion

A key objective of KMS implementations is to enhance job outcomes, such as job performance and job satisfaction, in the context of KMS use. Against this backdrop, this research sought to identify the key KMS features that contribute positively to job outcomes and a key driver of the use of these features. We used a combination of a literature review and a qualitative study to identify and validate the key KMS features. We compared the effects of the magnitude of the use of the four features on job performance and job satisfaction respectively. Using a social network perspective, we identified help-seeking and help-providing ties as important drivers of the use of the key KMS features and job outcomes. We used a quantitative study to validate our model. Particularly, the results indicated help-seeking and help-providing ties were positively related to use of the key KMS features and use of the key KMS features were positively related to two key job outcomes (i.e., job performance and job satisfaction) except that post and search were not significantly related to job satisfaction, whereas comment and rate were not significantly related to job performance.

Although we argued that employees were likely to be satisfied with their jobs when they used the post feature to express ideas and thoughts (H2b), making postings or contributing knowledge can take a lot of time and employees may only want to do it to facilitate the completion of job tasks but may not actually enjoy doing it. We also argued that employees are likely to be satisfied when they used the search feature to find what they need (H2d). But using the search feature effectively may require additional learning and effort that employees may not enjoy. Our explanation of the non-significant relationships between use of the comment feature (H2e) and job performance and between use of the rate feature and job performance (H2g) are as follows. When employees made comments to others' postings, they were likely to help others resolve work problems and hence contribute directly to others' job performance but not their own job performance. Although making comments and providing

[4]As suggested by Gefen et al. (2011), we followed the guidelines offered in Gerbing and Anderson (1988) to conduct a comparison between our model and the saturated model that includes all possible paths. Results indicated that the significant paths in our model also remained significant in the saturated model and adding the paths via the saturated model did not significantly increase effect size.

ratings may help employees reflect on and grow their knowledge that could lead to better performance, employees may view making comments and providing ratings as better tools for self-expression and mainly use them for that purpose. Our findings of the four nonsignificant relationships between the four KMS features and job outcomes will be consistent with the findings related to the competing hypotheses (i.e., with use of the post and search features more strongly related to job performance, and use of the comment and rate features more strongly related to job satisfaction). Finally, help-seeking and help-providing ties affected both job performance and job satisfaction.

Theoretical Implications

A few key theoretical implications emerge from our findings. Our work contributes to the literature related to the implementation of KMSs. Whereas prior literature on KMS implementations mainly focuses on examining the antecedents of KMS use (e.g., He and Wei 2006; Kankanhalli et al. 2005), our work develops a nomological network related to KMS use by integrating IS and organizational behavior literatures. Our work suggests that incorporating organizational behavior theories (i.e., social networks) helps us better understand job outcomes in the context of KMS implementations. Our work indicates social interactions in the form of peer support ties played an important role in fostering employees' use of a KMS to enhance job outcomes. Our work suggests peer support ties facilitated key behaviors (i.e., use of key KMS features) that are in turn drivers of job performance and job satisfaction. Future work can build on our findings related to social interactions. Whereas most prior research takes a static view on social interactions, a dynamic view on the evolution of the social relationships may shed new light on understanding KMS implementations.

This work enriches our understanding of large-scale collaborative system implementations within and across organizations (e.g., Rai et al. 2010; Venkatesh and Bala 2012). There is a limited understanding of how to leverage such systems to facilitate job outcomes. In filling this gap, our work conceptualized KMS use at the feature level, distinguished between help-seeking and help-providing ties, and differentiated the mechanisms explaining different job outcomes. One advantage of conceptualizing KMS use at the feature level was to identify the key features that contributed positively to job outcomes. It is critical to identify these features because employees will be likely to spend most of their time using only a small number of features to get their jobs done (e.g., Gaur and Soni 2011). In addition, we found that, even in a KMS use context, job satisfaction and job performance were not dependent on the same KMS features and such findings can only be discovered when KMS use was conceptualized at the feature level. Specifically, we found that post and search had a stronger effect on job performance, whereas comment and rate had a strong effect on job satisfaction. This work thus provides us a better understanding of the relationship between technology use and job outcomes by examining the effects of technology use at a granular level, such as at the feature level. Consequently, we gain a richer understanding of how a specific context (see Hong et al. 2014; Johns 2006; Venkatesh et al. 2010), for example, KMS implementation, plays a key role in advancing our knowledge about job outcomes.

Our work extends organizational behavior research using a social network perspective to understand job outcomes (e.g., Cross and Cummings 2004; Mehra et al. 2001). Our conceptualization of peer support ties as help-seeking and help-providing ties helped us gain greater insight into the impacts of networks on job outcomes (i.e., the magnitude of effects on different job outcomes varies across different ties). Specifically, help-seeking ties had a stronger impact on job performance, whereas help-providing ties had a stronger impact on job satisfaction. Our work thus responds to the call for research to understand the role of peer support ties in affecting technology use and job outcomes (e.g., Sykes et al. 2009; Venkatesh and Bala 2008) and complements more recent research on social networks and IS implementations (Sykes 2015; Sykes and Venkatesh 2017; Sykes et al. 2014).

Our work adopts a mixed methods approach that combines both qualitative and quantitative studies. Such an approach is superior to either a quantitative or a qualitative method because it provides greater validity to our model specification and model validation (Venkatesh et al. 2013; Venkatesh, Brown, and Sullivan 2016). Our first, qualitative study provides greater validity to model specification. By offering information about how employees evaluate different design features and why they think some features are more important than others, we validated the four features derived from prior KMS literature. Our second, quantitative study provided model validation. In addition, we collected data from multiple sources and at multiple points in time. The use of multiple sources of data significantly mitigates the risk of common method bias (Podsakoff et al. 2003). We also have more confidence in the validity of the model due to the data being collected at multiple points in time.

Limitations and Future Research

Our work identified some key KMS features that contributed positively to job outcomes. One limitation is that data were collected from only one organization and one type of KMS,

although we followed a rigorous approach to identify these features. To address the concern of generalizability, future research should examine KMSs with network-based systems and examine the key KMS features in other settings. Future research should also explore other KMS features or categories of features to determine whether there is a direct relationship between the use of these features and job outcomes. In addition, we should examine the content of use of different KMS features. For example, we can examine the content of postings to find out the purposes of using this feature (e.g., knowledge contribution, knowledge seeking or self-expression). We will then develop a more nuanced understanding of how the peer support network affects different purposes of use and how different purposes of use affect job outcomes. Moreover, we need to develop a better understanding of the ways in which different KMS features affect job outcomes. This may require future research to examine some mediating variables, some inter-linkages among different KMS features, and breadth of use or quality of use. For example, use of features that help establish identities may facilitate use of features that promote knowledge exchange given that employees may be more willing to exchange information, ideas, or knowledge when they get to know each other.

Our work indicated that peer support ties played a critical role in affecting the success of KMS implementations. Drawing from a social network perspective (e.g., Borgatti and Foster 2003), our work examined how peer support ties were related to KMS use and job outcomes. Due to practical constraints, we did not consider the changes in the networks. Future research should collect multiple waves of network data to gain a better understanding of how the change of networks affects KMS use and job outcomes. One limitation of our work was that we did not collect cross-unit network data; future work should include these ties, and examine their effects on KMS use and job outcomes. We do note that such a study will be challenging to conduct given that social network questionnaires grow in proportion to the sample size and number of networks (e.g., help-seeking, help-giving) being studied. Although KMS use was a key factor that affected the success of KMS implementations, future work should include other factors, such as how employees respond to an organizational change event in general, and examine how peer support ties help employees overcome challenges in this regard. Another interesting and key question is what facilitates the development of peer support networks. Future research should explore potential facilitators by drawing from relevant theoretical perspectives, for example, IT governance, friendship networks, justice, and task interdependence (Bowler and Brass 2006; Jasperson et al. 2005; Srivastava and Teo 2010; Tiwana 2009).

Practical Implications

Given that investments in large-scale collaborative systems, such as KMSs, continue to grow, organizations are keen to know how to reap the benefits from such investments. Given that employees will be likely to use a small number of features to get their jobs done, it is critical for employees to use the key (or the relatively more important) features that enhance their job performance and job satisfaction. Our work identified some of these features, thus providing employees with ideas about how to better leverage large-scale collaborative systems to accomplish their jobs. Our findings also inform managers how to facilitate job outcomes in the context of a large-scale collaborative system implementation. Given that some features can positively affect job outcomes, trainers can emphasize these features so as to make employees more familiar with the features and use them more effectively.

Our work identified not only the key KMS features that contribute positively to job outcomes, but also peer support ties as important drivers of the use of these features. When implementing large-scale ITs, such as KMSs, organizations rely on formal training or IT help-desks to aid employees in learning the use of new systems (Sykes 2015; Sykes et al. 2009). This research suggests organizations should leverage both formal and informal mechanisms to facilitate learning of new systems. Informal peer support networks affect use of KMS features through different mechanisms (e.g., power and influence, knowledge transfer). Organizations should think about how to create an environment to encourage communication and collaboration among peers that contribute to the development of peer support networks.

Our findings indicated the use of key KMS features affects the two job outcomes differently. Specifically, post and search affect job performance, whereas comment and rate affect job satisfaction. Leveraging these findings should help organizations design different interventions to achieve different job outcomes. Organizations need to think about how to foster an environment or a culture that makes employees feel more comfortable in using these features. Organizations should make employees aware that posting and commenting are highly valued behaviors. Consequently, employees will likely be motivated to use these features. Likewise, organizations should create more opportunities for employees to use these features, such as discussing postings, comments, and ratings during a meeting.

A broader implication for managers is that the success of large-scale collaborative system implementations is not simply dependent on technology factors, such as system design or functional capabilities of a system. Social factors, such as peer support, also play a critical role. Peer support

not only affected job outcomes mediated by technology use, but also affected job outcomes directly. A large-scale collaborative system implementation is a complicated process that requires management's attention to various aspects of different issues. This work suggests that managers can integrate social and technology factors to facilitate large-scale collaborative system success. One important social factor discussed in this paper was peer support and one important technology factor was feature use. Specifically, managers can facilitate peer support to enhance technology use and job outcomes. For example, managers may allow peers to form teams to discuss and resolve the challenges of using a system or work-related problems.

Conclusions

This work adds to the research on large-scale collaborative system, especially KMS, implementations by developing a better understanding of how to facilitate job outcomes (i.e., job performance and job satisfaction). Our work integrated the IS and organizational behavior literatures to understand job outcomes. We also demonstrated the important role of contextual variables—here, use of key KMS features in explaining job outcomes in the context of a KMS implementation. We further identified social interactions as key to explaining job outcomes. Conceptualization of KMS use at the feature level not only helped identify the key KMS features that affect job outcomes, but also helped distinguish features that affect job performance and those that affect job satisfaction. Overall, our nomological network of the use of key KMS features can be leveraged for future work on KMS implementations, collaborative systems, and job outcomes.

Acknowledgments

The authors wish to thank the senior editor, Suprateek Sarker, for his support and guidance throughout the review process. The authors are also thankful to the anonymous associate editor and three reviewers who provided valuable input that greatly helped improve the paper. Xiaojun also wishes to thank Fred Davis, Likoebe Maruping, Jon Johnson, and Rajiv Nag for their advice and guidance on his dissertation. This study was funded by the Early Career Scheme (ECS_647512) from the Hong Kong Research Grants Council. Thanks also to Jan DeGross for her efforts in typesetting this paper.

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Appendix

Factor Analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	CSE	**CON**	**CMS**	**TRN**	**PEOU**	**PU**	**LOKP**	**CE**	**OR**	**IMG**	**REC**	**KSE**	**ENJ**	**TRU**	**SAT**
CSE1	**.76**		.35	.41	.29						.25				
CSE2	**.77**		.40	.40	.34								.29		
CSE3	**.80**		.37	.35	.33										
CSE4	**.81**		.37	.33	.30										
CON1		**.70**						.28						.31	
CON2		**.74**					.26								
CON3	.28	**.73**							.29		.26				
CON4		**.72**													
CON5		**.76**				.26				.31					
CMS1			**.73**	.40			.29						.28		
CMS2	.29		**.74**	.42											
CMS3	.31		**.74**	.40			.27								
TRN1			.39	**.75**		.28									
TRN2	.26		.43	**.72**	.26								.30		
TRN3			.40	**.73**											
PEOU1	.29				**.74**	.28									
PEOU2	.28				**.78**	.31							.31		.26
PEOU3	.34				**.84**	.35									
PEOU4	.30				**.87**	.37									
PU1			.27		.40	**.91**				.28		.31			
PU2					.35	**.88**									
PU3				.25	.30	**.87**			.30		.28		.28		
LOKP1							**.71**								
LOKP2							**.74**					.32			
LOKP3							**.70**								
LOKP4				.35			**.72**								
CE1								**.73**			.27				
CE2								**.70**					.29		
CE3								**.74**							
OR1	.26								**.71**						
OR2									**.74**						
OR3				.28		.32			**.70**		.28				
OR4									**.73**			.33			
IMG1										**.80**					
IMG2		.27			.29					**.84**					.32
IMG3					.31					**.75**					
IMG4								.30		**.76**					
REC1											**.73**			.37	
REC2											**.77**			.35	
REC3							.33				**.70**			.33	
KSE1												**.71**			.26
KSE2		.28										**.74**			
KSE3									.27			**.77**			
KSE4			.29									**.78**			
ENJ1													**.71**		
ENJ2	.31												**.74**		
ENJ3											.31		**.79**		
ENJ4													**.82**		
TRU1		.28						.33				.44		**.83**	
TRU2									.29			.38		**.85**	
TRU3												.35		**.80**	
SAT1									.28		.29		.31		**.75**
SAT2															**.73**
SAT3															**.71**

Notes: 1. CSE = computer self-efficacy, CON = conscientiousness, CMS = change management support, TRN = training satisfaction, PEOU = perceived ease of use, PU = perceived usefulness, LOKP = loss of knowledge power, CE = codification effort, OR = organizational reward, IMG = image, REC = reciprocity, KSE = knowledge self-efficacy, ENJ = enjoyment in helping others, TRU = trust, SAT = job satisfaction.

2. Cross-loadings lower than .25 are not shown.